Black Holes And Time Warps Einsteins Outrageous Legacy Commonwealth Fund Book Program

The award-winning science writer “packs a lot of learning into a deceptively light and enjoyable read” exploring the contentious history of the black hole (New Scientist). For more than half a century, physicists and astronomers engaged in heated dispute over the possibility of black holes in the universe. The strange notion of a space-time abyss from which not even light escapes seemed to confound all logic. Now Marcia Bartusiak, author of Einstein’s Unfinished Symphony and The Day We Found the Universe, recounts the frustrating, exhilarating, and at times humorous battles over one of history’s most dazzling ideas. Bartusiak shows how the black hole helped revive Einstein’s greatest achievement, the general theory of relativity, after decades of languishing in obscurity. Not until astronomers discovered such surprising new phenomena as neutron stars and black holes did the once-sedate universe transform into an Einsteinian cosmos, filled with sources of titanic energy that can be understood only in the light of relativity. Black Hole explains how Albert Einstein, Stephen Hawking, and other leading thinkers completely changed the way we see the universe.

“It is said that fact is sometimes stranger than fiction, and nowhere is that more true than in the case of black holes. Black holes are stranger than anything dreamed up by science fiction writers.” In 2016 Professor Stephen Hawking delivered the BBC Reith Lectures on a subject that fascinated him for decades – black holes. In these flagship lectures the legendary physicist argued that if we could only understand black holes and how they challenge the very nature of space and time, we could unlock the secrets of the universe.

Bringing the material up to date, Black Holes, Wormholes and Time Machines, Second Edition captures the new ideas and discoveries made in physics since the publication of the best-selling first edition. While retaining the popular format and style of its predecessor, this edition explores the latest developments in high-energy astroparticle physics and Big Bang cosmology. The book continues to make the ideas and theories of modern physics easily understood by anyone, from researchers to students to general science enthusiasts. Taking you on a journey through space and time, author Jim Al-Khalili covers some of the most fascinating topics in physics today, including: Black holes Space warps The Big Bang Time travel Wormholes Parallel universes Professor Al-Khalili explains often complex scientific concepts in simple, nontechnical terms and imparts an appreciation of the cosmos, helping you see how time traveling may not be so far-fetched after all.

Writing for the general reader or student, Wald has completely revised and updated this highly regarded work to include recent developments in black hole physics and cosmology. Nature called the first edition "a very readable and accurate account of modern relativity physics for the layman within the unavoidable constraint of almost no mathematics. . . . A well written, entertaining and authoritative book."

Time Travel and Warp Drives

Black Holes & Time Warps: Einstein's Outrageous Legacy (Commonwealth Fund Book Program)

Friendship, Obsession and Betrayal in the Quest for Black Holes

Geons, Black Holes, and Quantum Foam: A Life in Physics

A Scientific Odyssey Through Parallel Universes, Time Warps, and the Tenth Dimension

Gravity's Fatal Attraction

A NEW YORK TIMES EDITOR'S CHOICE Einstein’s Shadow follows a team of elite scientists on their historic mission to take the first picture of a black hole, putting Einstein’s theory of relativity to its ultimate test and helping to answer our deepest questions about space, time, the origins of the universe, and the nature of reality Photographing a black hole sounds impossible, a contradiction in terms. But Shep Doeleman and a global coalition of scientists are on the cusp of doing just that. With exclusive access to the team, journalist Seth Fletcher spent five years following Shep and an extraordinary cast of characters as they assembled the Event Horizon Telescope, a virtual radio observatory the size of the Earth. He witnessed their struggles, setbacks, and breakthroughs, and along the way, he explored the latest thinking on the most profound questions about black holes. Do they represent a limit to our ability to understand reality? Or will they reveal the clues that lead to the long-sought Theory of Everything? Fletcher transforms astrophysics into something exciting, accessible, and immediate, taking us on an incredible adventure to better understand the complexity of our galaxy, the boundaries of human perception and knowledge, and how the messy human endeavor of science really works. Weaving a compelling narrative account of human ingenuity with excursions into cutting-edge science, Einstein’s Shadow is a tale of great minds on a mission to change the way we understand our universe—and our place in it.

This self-contained textbook brings together many different branches of physics--e.g. nuclear physics, solid state physics, particle physics, hydrodynamics, relativity--to analyze compact objects. The latest astronomical data is assessed. Over 250 exercises.

"[Tyson] tackles a great range of subjects…with great humor, humility, and—most important—humanity." —Entertainment Weekly Loyal readers of the monthly "Universe" essays in Natural History magazine have long recognized Neil deGrasse Tyson's talent for guiding them through the mysteries of the cosmos with clarity and enthusiasm. Bringing together more than forty of Tyson's favorite essays, Death by Black Hole explores a myriad of cosmic topics, from what it would be like to be inside a black hole to the movie industry's feeble efforts to get its night skies right. One of America's best-known astrophysicists, Tyson is a natural teacher who simplifies the complexities of astrophysics while sharing his infectious fascination for our universe.

- A unique exposition of the foundations of the quantum theory of black holes including the impact of string theory, the idea of black hole complementarily and the holographic principle bull; Aims to educate the physicist or student of physics who is not an expert on string theory, on the revolution that has grown out of black hole physics and string theory

An Introduction to Black Holes, Information and the String Theory Revolution

Black Holes

The Holographic Universe

Dark Matter and Dark Energy

The Future of Spacetime

My Battle with Stephen Hawking to Make the World Safe for Quantum Mechanics

In August 1930, on a boat trip from Bombay to England, the young Indian scientist Subrahmanyan Chandrasekhar calculated that certain stars could end their lives by collapsing indefinitely to a point - to nowhere. This idea brought Chandra into conflict with Sir Arthur Eddington, the grand old man of British astrophysics, who publicly ridiculed the idea. EMPIRE OF THE STARS teases out the major implications of this infamous event, setting it against the backdrop of the turbulent growth of astrophysics, and provides a unique window on our unfolding view of the cosmos. In its clash of personalities, epochs and cultures, the story reveals the deep-seated psychological and philosophical prejudices at work in the acceptance and rejection of new scientific ideas. Beautifully written, artfully constructed, EMPIRE OF THE STARS is a serious book but one which also deals with classic themes -- a lone man struggling against the establishment, intellectual rivalry and the highs and lows of great individuals set against the broader sweep of history.

Presents essays that explore the deepest mysteries of the universe, including black holes, gravity holes, and time travel, by physicists Stephen Hawking, Kip S. Thorne, Igor Novikov, Timothy Ferris, and Alan Lightman.

Ever since Albert Einstein's General Theory of Relativity burst upon the world in 1915, some of the world's most brilliant minds have sought to decipher the mysteries bequeathed by that legacy. Einstein himself was resistant to its implications, but physicists, astronomers and cosmologists have argued over his theory ever since.

Offers an accessible introduction to black holes requiring no mathematical background.

Death by Black Hole: And Other Cosmic Quandaries

Black Holes, Wormholes and Time Machines, Second Edition

100 Years of Relativity

Space-time Structure : Einstein and Beyond

Optics, Fluids, Plasmas, Elasticity, Relativity, and Statistical Physics

Exploring Black Holes

The universe has many secrets. It may hide additional dimensions of space other than the familier three we recognize. There might even be another universe adjacent to ours, invisible and unattainable . . . for now. Warped Passages is a brilliantly readable and altogether exhilarating journey that tracks the arc of discovery from early twentieth-century physics to the razor's edge of modern scientific theory. One of the world's leading theoretical physicists, Lisa Randall provides astonishing scientific possibilities that, until recently, were restricted to the realm of science fiction. Unraveling the twisted threads of the most current debates on relativity, quantum mechanics, and gravity, she explores some of the most fundamental questions posed by Nature—taking us into the warped, hidden dimensions underpinning the universe we live in, demystifying the science of the myriad worlds that may exist just beyond our own.

The astonishing science of black holes and their role in understanding the history and future of our universe. Black holes are the most extreme objects in the universe, and yet they are ubiquitous. Every massive star leaves behind a black hole when it dies, and every galaxy harbors a supermassive black hole at its center. Frighteningly enigmatic, these dark giants continue to astound even the scientists who spend their careers studying them. Which came first, the galaxy or its central black hole? What happens if you travel into one—instant death or something weirder? And, perhaps most important, how can we ever know anything for sure about black holes when they destroy information by their very nature? In Einstein’s Monsters, distinguished astronomer Chris Impey takes readers on an exploration of these and other questions at the cutting edge of astrophysics, as well as the history of black holes’ role in theoretical physics—from confirming Einstein’s equations for general relativity to testing string theory. He blends this history with a poignant account of the phenomena scientists have witnessed while observing black holes: stars swarming like bees around the center of our galaxy; black holes performing gravitational waltzes with visible stars; the cymbal clash of two black holes colliding, releasing ripples in space-time. Clear, compelling, and profound, Einstein’s Monsters reveals how our comprehension of black holes is intrinsically linked to how we make sense of the universe and our place within it. From the small questions to the big ones—from the tiniest particles to the nature of space-time itself—black holes might be the key to a deeper understanding of the cosmos.

All the matter and light we can see in the universe makes up a trivial 5 per cent of everything. The rest is hidden. This could be the biggest puzzle that science has ever faced. Since the 1970s, astronomers have been aware that galaxies have far too little matter in them to account for the way they spin around: they should fly apart, but something concealed holds them together. That ’something' is dark matter – invisible material in five times the quantity of the familiar stuff of stars and planets. By the 1990s we also knew that the expansion of the universe was accelerating. Something, named dark energy, is pushing it to expand faster and faster. Across the universe, this requires enough energy that the equivalent mass would be nearly fourteen times greater than all the visible material in existence. Brian Clegg explains this major conundrum in modern science and looks at how scientists are beginning to find solutions to it.

Albert Einstein’s theory of general relativity describes the effect of gravitation on the shape of space and the flow of time. But for more than four decades after its publication, the theory remained largely a curiosity for scientists; however accurate it seemed, Einstein’s mathematical code—represented by six interlocking equations—was one of the most difficult to crack in all of science. That is, until a twenty-nine-year-old Cambridge graduate solved the great riddle in 1963. Roy Kerr’s solution emerged coincidentally with the discovery of black holes that same year and provided fertile testing ground—at long last—for general relativity. Today, scientists routinely cite the Kerr solution, but even among specialists, few know the story of how Kerr cracked Einstein’s code. Fulvio Melia here offers an eyewitness account of the events leading up to Kerr’s great discovery. Cracking the Einstein Code vividly describes how luminaries such as Karl Schwarzschild, David Hilbert, and Emmy Noether set the stage for the Kerr solution; how Kerr came to make his breakthrough; and how scientists such as Roger Penrose, Kip Thorne, and Stephen Hawking used the accomplishment to refine and expand modern astronomy and physics. Today more than 300 million supermassive black holes are suspected of anchoring their host galaxies across the cosmos, and the Kerr solution is what astronomers and astrophysicists use to describe much of their behavior. By unmasking the history behind the search for a real world solution to Einstein’s field equations, Melia offers a first-hand account of an important but untold story. Sometimes dramatic, often exhilarating, but always attuned to the human element, Cracking the Einstein Code is ultimately a showcase of how important science gets done.

Black Hole

The Little Book of Black Holes

The Black Hole War

Einstein's Monsters: The Life and Times of Black Holes

Black Hole Physics

Einstein's Shadow

An award-winning science writer presents a captivating collection of cosmological essays for the armchair astronomer The galaxy, the multiverse, and the history of astronomy are explored in this engaging compilation of cosmological tales by multiple-award-winning science writer Marcia Bartusiak. In thirty-two concise and engrossing essays, the author provides a deeper understanding of the nature of the universe and those who strive to uncover its mysteries. Bartusiak shares the back stories for many momentous astronomical discoveries, including the contributions of such pioneers as Beatrice Tinsley, with her groundbreaking research in galactic evolution, and Jocelyn Bell Burnell, the scientist who first discovered radio pulsars. An endlessly fascinating collection that you can dip into in any order, these pieces will transport you to ancient Mars, when water flowed freely across its surface; to the collision of two black holes, a cosmological event that released fifty times more energy than was radiating from every star in the universe; and to the beginning of time itself.

Stephen Hawking provides the introduction to a work that examines such bizarre phenomena as black holes, wormholes, singularities, gravitational waves, and time machines, exploring the fundamental principles that control the universe.

What is space? It isn't a question that most of us normally stop to ask. Space is the venue of physics; it's where things exist, where they move and take shape. Yet over the past few decades, physicists have discovered a phenomenon that operates outside the confines of space and time. The phenomenon-the ability of one particle to affect another instantly across the vastness of space-appears to be almost magical. Einstein grappled with this oddity and couldn't quite resolve it, describing it as "spooky action at a distance." But this strange occurrence has direct connections to black holes, particle collisions, and even the workings of gravity. If space isn't what we thought it was, then what is it?In Spooky Action at a Distance, George Musser sets out to answer that question, offering a provocative exploration of nonlocality and a celebration of the scientists who are trying to understand it. Musser guides us on an epic journey of scientific discovery into the lives of experimental physicists observing particles acting in tandem, astronomers discovering galaxies that look statistically identical, and cosmologists hoping to unravel the paradoxes surrounding the big bang. Their conclusions challenge our understanding not only of space and time but of the origins of the universe-and their insights are spurring profound technological innovation and suggesting a new grand unified theory of physics.

Reissued in new covers, this is the run-away bestseller from one of the world's leading theoretical physicists. Are there other dimensions beyond our own? Is time travel possible? Michio Kaku takes us on a tour of the most exciting work in modern physics, including research into the 10th dimension, time warps, and multiple universes, to outline what may be the leading candidate for the Theory of Everything.

A Black Hole is Not a Hole

The Hidden 95% of the Universe

How an Idea Abandoned by Newtonians, Hated by Einstein, and Gambled on by Hawking Became Loved

Black Holes in the Universe

President's Scientists

Hawking on the Big Bang and Black Holes

Winner of the 2017 Nobel Prize in Physics Ever since Albert Einstein's general theory of relativity burst upon the world in 1915 some of the most brilliant minds of our century have sought to decipher the mysteries bequeathed by that theory, a legacy so unthinkable in some respects that even Einstein himself rejected them. Which of these bizarre phenomena, if any, can really exist in our universe? Black holes, down which anything can fall but from which nothing can return; wormholes, short spacewarps connecting regions of the cosmos; singularities, where space and time are so violently warped that time ceases to exist and space becomes a kind of foam; gravitational waves, which carry symphonic accounts of collisions of black holes billions of years ago; and time machines, for traveling backward and forward in time. Kip Thorne, along with fellow theorists Stephen Hawking and Roger Penrose, a cadre of Russians, and earlier scientists such as Oppenheimer, Wheeler and Chandrasekhar, has been in the thick of the quest to secure answers. In this masterfully written and brilliantly informed work of scientific history and explanation, Dr. Thorne, a Nobel Prize-winning physicist and the Feynman Professor of Theoretical Physics Emeritus at Caltech, leads his readers through an elegant, always human, tapestry of interlocking themes, coming finally to a uniquely informed answer to the great question: what principles control our universe and why do physicists think they know the things they think they know? Stephen Hawking's A Brief History of Time has been one of the greatest best-sellers in publishing history. Anyone who struggled with that book will find here a more slowly paced but equally mind-stretching experience, with the added fascination of a rich historical and human component. Winner of the Phi Beta Kappa Award in Science.

A journey through the otherworldly science behind Christopher Nolan’s award-winning film, Interstellar, from executive producer and Nobel Prize-winning physicist Kip Thorne. Interstellar, from acclaimed filmmaker Christopher Nolan, takes us on a fantastic voyage far beyond our solar system. Yet in The Science of Interstellar, Kip Thorne, the Nobel prize-winning physicist who assisted Nolan on the scientific aspects of Interstellar, shows us that the movie’s jaw-dropping events and stunning, never-before-attempted visuals are grounded in real science. Thorne shares his experiences working as the science adviser on the film and then moves on to the science itself. In chapters on wormholes, black holes, interstellar travel, and much more, Thorne’s scientific insights—many of them triggered during the actual scripting and shooting of Interstellar—describe the physical laws that govern our universe and the truly astounding phenomena that those laws make possible. Interstellar and all related characters and elements are trademarks of and © Warner Bros. Entertainment Inc. (s14).

Thanks to Einstein"s relativity theories, our notions of space and time underwent profound revisions about a 100 years ago. The resulting interplay between geometry and physics has dominated all of fundamental physics since then. This volume contains contributions from leading researchers, worldwide, who have thought deeply about the nature and consequences of this interplay. The articles take a long-range view of the subject and distill the most important advances in broad terms, making them easily accessible to non-specialists. The first part is devoted to a summary of how relativity theories were born (J Stachel). The second part discusses the most dramatic ramifications of general relativity, such as black holes (P Chrusciel and R Price), space-time singularities (H Nicolai and A Rendall), gravitational waves (P Laguna and P Saulson), the large scale structure of the cosmos (T Padmanabhan); experimental status of this theory (C Will) as well as its practical application to the GPS system (N Ashby). The last part looks beyond Einstein and provides glimpses into what is in store for us in the 21st century. Contributions here include summaries of radical changes in the notions of space and time that are emerging from quantum field theory in curved space-times (Ford), string theory (T Banks), loop quantum gravity (A Ashtekar), quantum cosmology (M Bojowald), discrete approaches (Dowker, Gambini and Pullin) and twistor theory (R Penrose).

This unique book offers a concise, introductory overview of general relativity and black holes, motivating students to become active participants in carrying out their own investigations. To this end, the book uses calculus and algebra, rather than tensors, to make general relativity accessible to sophomores and juniors. Five chapters introduce basic concepts, and seven projects require the reader to apply these basic concepts to real astronomical applications.

Space, Time, and Gravity

Unraveling the Mysteries of the Universe's Hidden Dimensions

Relativity and the Birth of Black Hole Physics

Basic Concepts and New Developments

The Membrane Paradigm

Dispatches from Planet 3

A black hole isn't really a hole . . . is it? Get ready to S-T-R-E-T-C-H your mind with this beloved and best-selling science book. Updated with an all-new chapter about the first black-hole image ever! What are black holes, what causes them, and how the heck did scientists discover them? Acclaimed STEM writer Carolyn DeCristofano's playful text shares how astronomers find black holes, introduces our nearest black-hole neighbors, and provides an excellent introduction to an extremely complex scientific topic. Gorgeous space paintings supplement real telescopic images, and funny doodles and speech bubbles keep the content light and fun.

What happens when something is sucked into a black hole? Does it disappear? Three decades ago, a young physicist named Stephen Hawking claimed it did-and in doing so put at risk everything we know about physics and the fundamental laws of the universe. Most scientists didn't recognize the import of Hawking's claims, but Leonard Susskind and Gerard t'Hooft realized the threat, and responded with a counterattack that changed the course of physics. THE BLACK HOLE WAR is the thrilling story of their united effort to reconcile Hawking's revolutionary theories of black holes with their own sense of reality-effort that would eventually result in Hawking admitting he was wrong, paying up, and Susskind and t'Hooft realizing that our world is a hologram projected from the outer boundaries of space. A brilliant book about modern physics, quantum mechanics, the fate of stars and the deep mysteries of black holes, Leonard Susskind's account of the Black Hole War is mind-bending and exhilarating reading.

D. Allan Bromley, the first person to hold the cabinet-level rank of Science Advisor to the President, here writes an engrossing memoir of his years at the Bush White House, bringing the unique perspective of a scientist to the political realities of policy making with the President and his other Senior Assistants. Bromley's account is both a broad overview of the role of science and technology in the Bush Administration and an insider's account of the ambiance, personalities, and politics that mold policy decisions in Washington. "A delightfully candid and deeply informed and reflective look at critical issues and events at a turning point in the history of government-science relations." -Bruce L. R. Smith, Brookings Institution "From the unique perspective of the only senior staff member in the Bush administration who reported both to the President and the Congress, Bromley gives us discerning new views on leading players in the Washington and world drama." -R. Gordon Hoxie, Editor, Presidential Studies Quarterly

With his unique knack for making cutting-edge theoretical science effortlessly accessible, world-renowned physicist Paul Davies now tackles an issue that has boggled minds for centuries: Is time travel possible? The answer, insists Davies, is definitely yes—once you iron out a few kinks in the space-time continuum. With tongue placed firmly in cheek, Davies explains the theoretical physics that make visiting the future and revisiting the past possible, then proceeds to lay out a four-stage process for assembling a time machine and making it work. Wildly inventive and theoretically sound, How to Build a Time Machine is creative science at its best—illuminating, entertaining, and thought provoking.

Hyperspace

Modern Classical Physics

Updated Edition

Black Holes: The Reith Lectures

Warped Passages

Dive into a mind-bending exploration of the physics of black holes Black holes, predicted by Albert Einstein's general theory of relativity more than a century ago, have long intrigued scientists and the public with their bizarre and fantastical properties. Although Einstein understood that black holes were mathematical solutions to his equations, he never accepted their physical reality—a viewpoint many shared. This all changed in the 1960s and 1970s, when a deeper conceptual understanding of black holes developed just as new observations revealed the existence of quasars and X-ray binary star systems, whose mysterious properties could be explained by the presence of black holes. Black holes have since been the subject of intense research—and the physics governing how they behave and affect their surroundings is stranger and more mind-bending than any fiction. After introducing the basics of the special and general theories of relativity, this book describes black holes both as astrophysical objects and theoretical "laboratories" in which physicists can test their understanding of gravitational, quantum, and thermal physics. From Schwarzschild black holes to rotating and colliding black holes, and from gravitational radiation to Hawking radiation and information loss, Steven Gubser and Frans Pretorius use creative thought experiments and analogies to explain their subject accessibly. They also describe the decades-long quest to observe the universe in gravitational waves, which recently resulted in the LIGO observatories' detection of the distinctive gravitational wave "chirp" of two colliding black holes—the first direct observation of black holes' existence. The Little Book of Black Holes takes readers deep into the mysterious heart of the subject, offering rare clarity of insight into the physics that makes black holes simple yet destructive manifestations of geometric destiny.

A groundbreaking text and reference book on twenty-first-century classical physics and its applications This first-year graduate-level text and reference book covers the fundamental concepts and twenty-first-century applications of six major areas of classical physics that every masters- or PhD-level physicist should be exposed to, but often isn't: statistical physics, optics (waves of all sorts), elastodynamics, fluid mechanics, plasma physics, and special and general relativity and cosmology. Growing out of a full-year course that the eminent researchers Kip Thorne and Roger Blandford taught at Caltech for almost three decades, this book is designed to broaden the training of physicists. Its six main topical sections are also designed so they can be used in separate courses, and the book provides an invaluable reference for researchers. Presents all the major fields of classical physics except three prerequisites: classical mechanics, electromagnetism, and elementary thermodynamics Elucidates the interconnections between diverse fields and explains their shared concepts and tools Focuses on fundamental concepts and modern, real-world applications Takes applications from fundamental, experimental, and applied physics; astrophysics and cosmology; geophysics, oceanography, and meteorology; biophysics and chemical physics; engineering and optical science and technology; and information science and technology Emphasizes the quantum roots of classical physics and how to use quantum techniques to elucidate classical concepts or simplify classical calculations Features hundreds of color figures, some five hundred exercises, extensive cross-references, and a detailed index An online illustration package is available

Black Holes and Time WarpsEinstein's Outrageous LegacyW. W. Norton & Company

It is not an exaggeration to say that one of the most exciting predictions of Einstein's theory of gravitation is that there may exist "black holes": putative objects whose gravitational fields are so strong that no physical bodies or signals can break free of their pull and escape. The proof that black holes do exist, and an analysis of their properties, would have a significance going far beyond astrophysics. Indeed, what is involved is not just the discovery of yet another even if extremely remarkable, astro physical object, but a test of the correctness of our understanding of the properties of space and time in extremely strong gravitational fields. Theoretical research into the properties of black holes, and into the possible corol laries of the hypothesis that they exist, has been carried out with special vigor since the beginning of the 1970's. In addition to those specific features of black holes that are important for the interpretation of their possible astrophysical manifestations, the theory has revealed a number of unexpected characteristics of physical interactions involving black holes. By the middle of the 1980's a fairly detailed understanding had been achieved of the properties of the black holes, their possible astrophysical manifestations, and the specifics of the various physical processes involved. Even though a completely reliable detection of a black hole had not yet been made at that time, several objects among those scrutinized by astrophysicists were considered as strong candidates to be confirmed as being black holes.

The Physics of Compact Objects

Einstein's Telescope: The Hunt for Dark Matter and Dark Energy in the Universe

Introduction to General Relativity

The Theory of the Big Bang and Black Holes

In Search of the Edge of Time

The Phenomenon That Reimagines Space and Time--and What It Means for Black Holes, the Big Bang, and Theories of Everything

A pedagogical introduction to the physics of black holes. The membrane paradigm represents the four-dimensional spacetime of the black hole's "event horizon" as a two-dimensional membrane in three-dimensional space, allowing the reader to understand and compute the behavior of black holes in complex astrophysical environments.

"Splendidly satisfying reading, designed for a nonspecialist audience."—Kirkus Reviews, starred review Evalyn Gates, a talented astrophysicist, transports readers to the edge of contemporary science to explore the revolutionary tool—"Einstein's telescope"—that is unlocking the secrets of the Universe. Einstein's telescope, or gravitational lensing, is so-called for the way gravity causes space to distort and allow massive objects to act like "lenses," amplifying and distorting the images of objects behind them. By allowing for the detection of mass where no light is found, scientists can map out the distribution of dark matter and come a step closer to teasing out the effects of dark energy on the Universe—which may forever upend long-held notions about where the Universe came from and where it is going.

Discusses what people understand about space and time and how science fiction is becoming less fictional as time goes on.

The autobiography of one of the preeminent figures in twentieth-century physics. He studied with Niels Bohr, taught Richard Feynman, and boned up on relativity with his friend and colleague Albert Einstein. John Archibald Wheeler's fascinating life brings us face to face with the central characters and discoveries of modern physics. He was the first American to learn of the discovery of nuclear fission, later coined the term "black hole," led a renaissance in gravitation physics, and helped to build Princeton University into a mecca for physicists. From nuclear physics, to quantum theory, to relativity and gravitation, Wheeler's work has set the trajectory of research for half a century. His career has brought him into contact with the most brilliant minds of his field; Fermi, Bethe, Rabi, Teller, Oppenheimer, and Wigner are among those he called colleagues and friends. In this rich autobiography, Wheeler reveals in fascinating detail the excitement of each discovery, the character of each colleague, and the underlying passion for knowledge that drives him still.

Cracking the Einstein Code

Spooky Action at a Distance

Empire Of The Stars

32 (Brief) Tales on the Solar System, the Milky Way, and Beyond

Reminiscences of a White House Science Advisor

The Inside Story of Astronomers' Decades-Long Quest to Take the First Picture of a Black Hole

Examines such phenomena as black holes, wormholes, singularities, gravitational waves, and time machines, exploring the fundamental principles that control the universe.

Stephen Hawking, the Lucasian Professor of Mathematics at Cambridge University, has made important theoretical contributions to gravitational theory and has played a major role in the development of cosmology and black hole physics. Hawking's early work, partly in collaboration with Roger Penrose, showed the significance of spacetime singularities for the big bang and black holes. His later work has been concerned with a deeper understanding of these two issues. The work required extensive use of the two great intellectual achievements of the first half of the Twentieth Century: general relativity and quantum mechanics; and these are reflected in the reprinted articles. Hawking's key contributions on black hole radiation and the no-boundary condition on the origin of the universe are included. The present compilation of Stephen Hawking's most important work also includes an introduction by him, which guides the reader though the major highlights of the volume. This volume is thus an essentialitem in any library and will be an important reference source for those interested in theoretical physics and applied mathematics. It is an excellent thing to have so many of Professor Hawking's most important contributions to the theory of black holes and space-time singularities all collected together in one handy volume. I am very glad to have them". Roger Penrose (Oxford) "This was an excellent idea to put the best papers by Stephen Hawking together. Even his papers written many years ago remain extremely useful for those who study classical and quantum gravity. By watching the evolution of his ideas one can get a very clear picture of the development of quantum cosmology during thelast quarter of this century". Andrei Linde (Stanford) "This review could have been quite short: 'The book contains a selection of 21 of Stephen Hawking's most significant papers with an overview written by the author'. This w

Richly illustrated with the images from observatories on the ground and in space, and computer simulations, this book shows how black holes were discovered, and discusses our current understanding of their role in cosmic evolution. This second edition covers new discoveries made in the past decade, including definitive proof of a black hole at the center of the Milky Way, evidence that the expansion of the Universe is accelerating, and the new appreciation of the connection between black holes and galaxy formation. There are entirely new chapters on gamma-ray bursts and cosmic feedback. Begelman and Rees blend theoretical arguments with observational results to demonstrate how both approaches contributed to this subject. Clear illustrations and photographs reveal the strange and amazing workings of our universe. The engaging style makes this book suitable for introductory undergraduate courses, amateur astronomers, and all readers interested in astronomy and physics.

Black Holes and Time Warps

Einstein's Outrageous Legacy

The Science of Interstellar

A Scientific Guide to Shortcuts Through Time and Space

Black Holes, White Dwarfs, and Neutron Stars

How to Build a Time Machine